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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Osamu Shimamura et al.
Serial No.:	10/574,032
Filing Date:	March 27, 2006
Examiner/Art Unit:	A. Arciero/1795
Title:	LITHIUM-ION BATTERY AND METHOD FOR ITS MANUFACTURE

APPEAL BRIEF

M.S. Appeal
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Please enter the following Appeal Brief in the Appeal filed on March 5, 2010.

REAL PARTY IN INTEREST

The real party in interest is Nissan Motor Co., Ltd., a corporation organized and existing under the laws of Japan and having a principle place of business at 2 Takara-cho, Kanagawa-ku, Yokohama-shi, Kanagawa, Japan 221-0023.

RELATED APPEALS AND INTERFERENCES

There are no related prior or pending appeals, interferences or judicial proceedings known to appellant or appellant's legal representative.

STATUS OF CLAIMS

Claims 1, 3-16 and 20-27 stand finally rejected under 35 U.S.C. § 103(a) by the Examiner as noted in the final Office Action mailed November 5, 2009. Claims 2, 17-19, 28 and 29 were canceled. The rejection of claims 1, 3-16 and 20-27 is appealed.

STATUS OF AMENDMENTS

There are no pending amendments. A Response after final was filed on December 14, 2009, in which no claims were added or amended or canceled. The Response was entered and considered according to the Advisory Action mailed January 11, 2010. A

supplemental Response after final was filed on January 15, 2010, in which no claims were added or amended or canceled. The Response was entered and considered according to the Advisory Action mailed March 9, 2010.

SUMMARY OF CLAIMED SUBJECT MATTER

Claim 1

Claim 1 recites a lithium ion battery (pg. 5, l. 9) comprising a cathode (FIGS. 1, 2, 5A, 5C and 7A-C, ref. 3; pg. 5, l. 22), an anode (FIGS. 1, 2, 5A, 5C and 7A-C, ref. 2; pg. 5, l. 21) and an electrolyte layer (FIGS. 2 and 5A-7D, ref. 4; pg. 5, l. 23) between the cathode and the anode. The cathode, the anode, and the electrolyte layer constitute a cell element (FIG. 2, ref. 6; pg. 6, ll. 15-16). The electrolyte layer (FIGS. 2 and 5A-7D, ref. 4; pg. 5, l. 23) consists essentially of a pattern of individual insulating particles (FIGS. 5A, 5B, 5E, 6A-6C and 7A-7D, ref. 4a; pg. 7, l. 15) with a plurality of interstitial spaces (pg. 7, l. 17) therebetween, with electrolytes (FIGS. 5A, 5B, 5E, 6A-6C and 7A-7D, ref. 4b; pg. 7, ll. 16-17) occupying at least some of the interstitial spaces (pg. 7, l. 17), wherein each individual insulating particle in the pattern (pg. 11, ll. 8-14) is selectively arranged (FIGS. 5B, 6A-6C, 7B and 7C, ref. 4a; pg. 8, ll. 15-19; pg. 9, ll. 6-30) directly on one of the cathode and anode (pg. 11, ll. 15-17), the individual insulating particles arranged such that the cathode and the anode do not contact each other (pg. 8, ll. 8-14; pg. 9, ll. 1-2).

Claim 10

Claim 10 recites a method for manufacturing a battery (pg. 5, l. 9) comprising applying individual insulating particles (FIGS. 5A, 5B, 5E, 6A-6C and 7A-7D, ref. 4a; pg. 7, l. 15) directly to at least one of a cathode (FIGS. 1, 2, 5A, 5C and 7A-C, ref. 3; pg. 5, l. 22) and an anode (FIGS. 1, 2, 5A, 5C and 7A-C, ref. 2; pg. 5, l. 21), applying an electrolytic polymer (FIGS. 5A, 5B, 5E, 6A-6C and 7A-7D, ref. 4b; pg. 7, ll. 16-17) to at least some of a plurality of interstitial spaces (pg. 7, l. 17) between the individually applied insulating particles to form an electrolyte layer and layering the cathode and the anode such that the electrolyte layer is formed in between (pg. 5, ll. 22-23).

Claim 15

Claim 15 recites a battery assembly comprising multiple connected batteries (pg. 36, ll. 6-13), wherein each of the connected batteries (FIG. 3, ref. 11; pg. 6, l. 6) comprises layered cell elements (FIG. 2, ref. 6; pg. 6, ll. 15-16) including a cathode (FIGS. 1, 2, 5A, 5C and 7A-C, ref. 3; pg. 5, l. 22) and an anode (FIGS. 1, 2, 5A, 5C and 7A-C, ref. 2;

pg. 5, l. 21) that are facing each other and an electrolyte layer (FIGS. 2 and 5A-7D, ref. 4; pg. 5, l. 23) between the cathode and the anode. Lithium ions (pg. 12, ll. 5-8) can be inserted into and removed from the cathode and the anode through the electrolyte layer (pg. 5, ll. 14-15). The electrolyte layer (FIGS. 2 and 5A-7D, ref. 4; pg. 5, l. 23) consists essentially of individual insulating particles (FIGS. 5A, 5B, 5E, 6A-6C and 7A-7D, ref. 4a; pg. 7, l. 15) individually applied (pg. 7, ll. 27-28; pg. 21, ll. 2-3) directly to at least one of the cathode and the anode (pg. 11, ll. 15-17) and affixed thereto, and electrolytes (FIGS. 5A, 5B, 5E, 6A-6C and 7A-7D, ref. 4b; pg. 7, ll. 16-17) occupying at least some of a plurality of interstitial spaces (pg. 7, l. 17) between the individual insulating particles.

<u>Claim 16</u>

Claim 16 recites a vehicle (pg. 36, ll. 20-27) having a battery assembly comprising multiple connected batteries (pg. 36, ll. 6-13) mounted as a power supply for a drive train of the vehicle (pg. 36, ll. 20-27), wherein each of the connected batteries (FIG. 3, ref. 11; pg. 6, l. 6) comprises layered cell elements (FIG. 2, ref. 6; pg. 6, ll. 15-16) including a cathode (FIGS. 1, 2, 5A, 5C and 7A-C, ref. 3; pg. 5, l. 22) and an anode (FIGS. 1, 2, 5A, 5C and 7A-C, ref. 2; pg. 5, l. 21) that are facing each other and an electrolyte layer (FIGS. 2 and 5A-7D, ref. 4; pg. 5, l. 23) between the cathode and the anode. Lithium ions (pg. 12, ll. 5-8) can be inserted into and removed from the cathode and the anode through the electrolyte layer (pg. 5, ll. 14-15). The electrolyte layer (FIGS. 2 and 5A-7D, ref. 4; pg. 5, l. 23) consists essentially of individual insulating particles (FIGS. 5A, 5B, 5E, 6A-6C and 7A-7D, ref. 4a; pg. 7, l. 15) individually affixed (pg. 7, ll. 27-28; pg. 21, ll. 2-3) directly to at least one of the cathode and the anode (pg. 11, ll. 15-17) and electrolytes (FIGS. 5A, 5B, 5E, 6A-6C and 7A-7D, ref. 4b; pg. 7, ll. 16-17) positioned such that the electrolytes (FIGS. 5A, 5B, 5E, 6A-6C and 7A-7D, ref. 4b; pg. 7, ll. 16-17) occupy at least some of a plurality of interstitial spaces (pg. 7, l. 17) between the affixed individual insulating particles.

<u>GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL</u>

1. Claims 1, 4-6, 8-14 and 20-23 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Hisamitsu et al. (US 2004/0126655) in view of Delnick (US 5,865,860);
2. Claim 3 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Hisamitsu in view of Delnick and in further view of Kung (US 5,389,471);

3. Claims 15, 16, 24 -27 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Hisamitsu in view of Delnick and in further view of Triplett (US 3,566,985); and
4. Claim 7 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Hisamitsu in view of Delnick and in further view of Munshi (US 6,645,675).

ARGUMENT

1. Rejection of claims 1, 4-6, 8-14 and 20-23

The Examiner rejects claims 1, 4-6, 8-14 and 20-23 under 35 U.S.C. §103(a) as being unpatentable over Hisamitsu (2004/0126655) in view of Delnick (5,865,860). Applicants' claim 1 recites a lithium ion battery comprising a cathode, an anode and an electrolyte layer between the cathode and the anode, wherein the cathode, the anode, and the electrolyte layer constitute a cell element. The electrolyte layer consists essentially of a pattern of individual insulating particles with a plurality of interstitial spaces therebetween, with electrolytes occupying at least some of the interstitial spaces, wherein each individual insulating particle in the pattern is selectively arranged directly on one of the cathode and anode, the individual insulating particles arranged such that the cathode and the anode do not contact each other.

The Examiner contends that Hisamitsu et al. (US 2004/0126655) discloses all of the elements of claim 1 except for the claimed electrolyte layer. (Office Action, p. 2). However, the Examiner states that Hisamitsu et al. teaches using an ink-jet method to form all the layers of the battery including the electrolyte layer. (Id.) Since Delnick (US 5,865,860) teaches an electrolyte layer comprising a porous separator structure comprising individual insulting particles of silica or alumina and a polymer binder (citing col. 5, ll. 36-57), wherein electrolytes are applied via ink-jet printing to uniformly occupy the interstitial spaces of the porous separator structure (citing Abstract), the Examiner states that the combination teaches the invention. (Office Action, pp. 2-3). Moreover, the Examiner takes the position that the electrolyte layer of Delnick produced by Hisamitsu et al. would inherently "consist essentially of" a pattern of insulating particles comprising a plurality of interstitial spaces therebetween such that electrolytes occupy a majority of the interstitial spaces.

The Examiner's rejection ignores certain language of the claim. First, claim 1 requires that the electrolyte layer consists essentially of a pattern of individual insulating

particles and that each individual insulating particle in the pattern be selectively arranged directly on one of the cathode and anode and arranged such that the cathode and the anode do not contact each other.

With regard to these elements, the Examiner states in his Advisory Action dated January 11, 2010 that Hisamitsu teaches layers that are formed in a predetermined pattern in paragraph [0039]. However, the claims require that the individual insulating particles be placed in a pattern. The claims do not require the layers be formed in a predetermined pattern as stated by the Examiner. Paragraph [0039] is reproduced in part below.

> The five printer heads are for applying a positive electrode fluid for forming the positive electrode layers 211a, a negative electrode fluid for forming the negative electrode layers 211c, an electrolyte fluid for forming the electrolyte layers 211fc, a conductive fluid for forming the collector layers 212 and the electric circuit portion 300, and an insulating fluid for forming the insulating portion 400, respectively. By controlling these printer heads, each of the fluid types mentioned above is ejected onto the substrate in a predetermined pattern respectively. After a solvent contained in the fluid is evaporated and the fluid is solidified, each of the fluid types is ejected to overlay the solidified fluid in a predetermined pattern to be formed next.

Paragraph [0040] goes on to describe FIG. 5, which shows "the patterns of the respective layers of the laminate type battery according to this embodiment, that is, ejection patterns of the fluids. The laminate type battery of this embodiment can be manufactured by forming each of the patterns shown in FIG. 5 one after another on the substrate from the first layer to the uppermost layer." Paragraph [0041] continues to describe how the "pattern" of layers is manufactured. "First of all, the insulating fluid is ejected from the inkjet printer onto the substrate and then dried, thus forming an insulating layer serving as the lowermost layer. Next, the conductive fluid and the insulating fluid are ejected onto the insulating layer and then dried, thus forming a collecting layer 212c serving as the second layer."

Applicants submit that clearly, based on these paragraphs and FIG. 5, Hisamitsu is referring to the pattern in which the layers are formed, not a pattern in which individual insulating particles of the electrolyte layers are formed.

Delnick describes a separator layer 208 made of a suitable mixture of a solid particulate, such as alumina or silica, and a polymer binder. (Col. 5, ll. 44-47). Because it is a mixture, it is impossible for the individual particles therein to be patterned as claimed. That

is, the solid particulate is mixed in the polymer binder such that the separator layer 208 is formed. No pattern of the solid particulate is formed. Moreover, as illustrated schematically in FIG. 4 of Delnick, the solid particulate is mixed throughout the polymer binder in the separator layer 208, not in contact directly with the interface 209 with active electrode layer 206. Accordingly, no pattern is formed by particles directly on one of a cathode or anode. This would be contrary to the teaching in Delnick that the porous structure of the separator layer 208, when present, continuously extends into the first layer 206 through the interface 209. (Col. 5, ll. 29-35).

Applicants further submit that the Examiner's rejection does not properly address the meaning of the phrase "consisting essentially of" with respect to the claimed electrolyte layer. As mentioned above, the separator layer 208 of Delnick, when present, comprises a mixture of a solid particulate, such as alumina or silica, and a polymer binder. (Col. 5, ll. 44-47). The transitional phrase "consisting essentially of" limits the scope of a claim (or claim element) to the specified materials or steps "and those that do not materially affect the basic and novel characteristic(s)" of the claimed invention or element. *In re Herz*, 537 F.2d 549, 551-52, 190 USPQ 461, 463 (CCPA 1976) (emphasis in original). Applicants submit that the Examiner has completely failed to make any findings of fact to support or even to state or express why the inclusion of a binder material in the mixed layer would not materially affect the basic and novel characteristics of the claimed electrolyte layer.

Applicants expressed this disagreement with the Examiner in the Reply to the final Office Action submitted December 14, 2009, stating that the Examiner was ignoring the inclusion of the binder in the Delnick separator. However, in an Advisory Action dated January 11, 2010, the Examiner indicates that "consisting essentially of" is interpreted as not excluding other elements, such as the binder of Delnick, since the structure of the separator material is further limited in other dependent claims. Applicants submit that this statement is incorrect as a matter of fact and of law. First, those of the dependent claims referring to the electrolyte layer do not add any new components to that layer—they merely further modify existing features of the electrolyte layer of claim 1. Second, "consisting essentially of" does not necessarily exclude other elements from the electrolyte layer, but it requires exclusion of those elements that materially affect the basic and novel characteristics of the electrolyte layer. Here, the patterned arrangement of insulating particles provides a high-strength gap that separates the electrodes to prevent short-circuiting while holding the electrolytes even in

the event of pressure on the battery from an external load and in the absence of an insulating seal layer around its periphery. (Applicants' ¶ [0044]). Nothing in Delnick teaches or suggests that the optional porous separator layer 208, which includes the binder, provides these basic and novel characteristics, and the Examiner does not address this issue.

Relatedly, and with regard to the Examiner's inherency position, Applicants submit that even if the separator layer 208 were applied with an ink-jet, which is not described in Delnick, the electrolyte layer of Delnick produced by Hisamitsu et al. would not inherently "consist essentially of" a pattern of insulating particles comprising a plurality of interstitial spaces therebetween such that electrolytes occupy a majority of the interstitial spaces. The application by inkjet would involve application of the binding layer <u>mixed</u> with the particles. As a result, and for the reasons described above, the Examiner has not met his burden of proof of "provid[ing] a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." *Ex parte Levy,* 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990).

Applicants respectfully submit that for the foregoing reasons, the combination of Hisamitsu and Delnick does not teach, suggest or render obvious to one skilled in the art the electrolyte layer claimed. Applicants respectfully submit that claim 1 and its dependent claims 3-6, 8, 9, 20 and 21 are allowable over the cited combination.

Applicants' independent method claim 10 recites in part applying individual insulating particles directly to at least one of a cathode and an anode and applying an electrolytic polymer to at least some of a plurality of interstitial spaces between the individually applied insulating particles to form an electrolyte layer. As noted by the Examiner (Office Action, pg. 5), Hisamitsu does not disclose the claimed method. The Examiner contends, however, that Delnick discloses applying individual insulating particles onto at least the cathode or anode and further filling the interstitial spaces with electrolyte. However, the Examiner does not acknowledge that separator layer 208 of Delnick is applied as a layer rather than as individual particles and does not address the fact that, even if it were applied by an ink-jet, for example, separator layer 208 would still not apply individual insulating particles directly due to the presence of the solid particulates in a mixture with the polymer binder. That is, the presence of the binder in Delnick would prevent application of

the insulating particles directly to at least one of a cathode and an anode, regardless of the teachings of Hisamitsu et al. Accordingly, no combination of Hisamitsu et al. and Delnick teaches at least the step of applying individual insulating particles directly to at least one of a cathode and an anode. Accordingly, Applicants respectfully submit that the combination of Hisamitsu and Delnick does not teach, suggest or render obvious to one skilled in the art claim 10 and its dependent claims 11-14, 22 and 23.

In addition to its dependency from claim 10, claim 12 includes additional features that make it allowable over the cited combination of references. Claim 12 recites that the electrolytic polymer is applied simultaneously with the individual insulating particles to form a solid electrolyte battery. The Examiner contends in his response to arguments that Hisamitsu discloses simultaneously applying electrolyte and separator. Hisamitsu discloses that the layers of the cell are formed *respectively* (¶ [0039]), or one after another, as described in paragraph [0040]. Hisamitsu states that because shape and position of the electrode terminals change, they can be simultaneously printed, as shown in FIGS. 7A-7D. Hisamitsu does not disclose applying insulating particles and electrolyte at the same time and thus in the same basic space. Hisamitsu only discloses using more than one ink jet head at the same time to print on different surfaces. Therefore, the invention of claim 12 is not rendered obvious by the cited combination of Hisamitsu and Delnick.

2. Rejection of claim 3

The Examiner rejects claim 3 under 35 U.S.C. §103(a) as being unpatentable over Hisamitsu in view of Delnick and in further view of Kung (5,389,471). Claim 3 depends from claim 1 to include all of the limitations therein and to further recite that a void ratio of the interstitial spaces to the individual insulating particles in the electrolyte layer is 50-90%. As the Examiner notes (Office Action, pg. 7) neither Hisamitsu nor Delnick disclose this limitation. As argued above with respect to claim 1 and incorporated herein, neither Hisamitsu nor Delnick disclose the electrolyte layer as recited in claim 1 as argued above. Therefore, for the combination of Hisamitsu, Delnick and Kung to render claim 3 obvious, Kung must render obvious in light of Hisamitsu and Delnick to one skilled in the art at the time the invention was made the electrolyte layer as recited. However, Kung also fails to disclose individual insulating particles having a plurality of interstitial spaces therebetween, with electrolytes occupying at least some of the interstitial spaces. Therefore, the cited

combination of references does not teach, suggest or render obvious the elements of claim 3 at least by its dependency from claim 1. Applicants respectfully submit that claim 3 is allowable over the cited combination for these reasons.

3. Rejection of claims 15, 16, 24 -27

The Examiner rejects claims 15, 16 and 24-27 under 35 U.S.C. §103(a) as being unpatentable over Hisamitsu in view of Delnick and in further view of Triplett (3,566,985). Applicants' independent claim 15 recites in part a battery assembly comprising multiple connected batteries, wherein each of the connected batteries comprises an electrolyte layer consisting essentially of individual insulating particles individually applied directly to at least one of the cathode and the anode and affixed thereto, and electrolytes occupying at least some of a plurality of interstitial spaces between the individual insulating particles. The deficiencies with respect to the combination of Hisamitsu et al. and Delnick argued with regard to the electrolyte layer of claim 1 apply to the electrolyte layer of claim 15 and are incorporated herein. Moreover, the Examiner's inclusion of Triplett (US 3,566,985) does not cure the deficiencies in that combination because Triplett is cited only for an electric vehicle driven by an electric motor powered by a DC battery having a plurality of cells. It does not teach or suggest the claimed electrolyte layer. Accordingly, the rejection of claim 15 and its dependent claims 24 and 25 under 35 USC §103(a) is traversed. Applicants respectfully submit that claims 15, 24 and 25 are allowable over the cited combination for these reasons.

Applicants' independent claim 16 recites in part a vehicle having a battery assembly comprising multiple connected batteries, wherein each of the connected batteries comprises an electrolyte layer consisting essentially of individual insulating particles individually applied directly to at least one of the cathode and the anode and affixed thereto, and electrolytes occupying at least some of a plurality of interstitial spaces between the individual insulating particles. The deficiencies with respect to the combination of Hisamitsu et al. and Delnick argued with regard to the electrolyte layer of claim 1 apply to the electrolyte layer of claim 16 and are incorporated herein. Moreover, the Examiner's inclusion of Triplett (US 3,566,985) does not cure the deficiencies in that combination because Triplett is cited only for an electric vehicle driven by an electric motor powered by a DC battery having a plurality of cells. It does not teach or suggest the claimed electrolyte layer. Accordingly, the

rejection of claim 16 and its dependent claims 26 and 27 under 35 USC §103(a) is traversed. Applicants respectfully submit that claims 16, 26 and 27 are allowable over the cited combination for these reasons.

4. Rejection of claim 7

Claim 7 is rejected under 35 U.S.C. §103(a) as being unpatentable over Hisamitsu in view of Delnick and in further view of Munshi (US 6,645,675). Claim 7 depends from claim 1 to include all of the limitations therein and to further recite that the individual insulating particles comprise olefin resins. As argued with reference to claim 1, which arguments are herein incorporated, neither Hisamitsu nor Delnick disclose the electrolyte layer of claim 1 consisting essentially of individual insulating particles having a plurality of interstitial spaces therebetween, with electrolytes occupying at least some of the interstitial spaces. Therefore, for the combination of Hisamitsu, Delnick and Munshi to render claim 7 obvious, Munshi must cure the deficiencies of Hisamitsu and Delnick. However, Munshi also fails to disclose the electrolyte layer recited in claim 1. Therefore, the cited combination of references does not teach, suggest or render obvious the elements of claim 7. Applicants respectfully submit that claim 7 is allowable over the cited combination for these reasons.

In conclusion, the Examiner's rejections of claims 1, 3-16 and 20-27 are improper and are reversible error. Reversal of the Examiner's rejections of these claims is respectfully requested. No oral hearing is requested.

Respectfully submitted,

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APPENDIX A: Claims Appendix

1. A lithium ion battery comprising:

a cathode;

an anode; and

an electrolyte layer between the cathode and the anode,

wherein the cathode, the anode, and the electrolyte layer constitute a cell element, and

wherein the electrolyte layer consists essentially of a pattern of individual insulating particles with a plurality of interstitial spaces therebetween, with electrolytes occupying at least some of the interstitial spaces, wherein each individual insulating particle in the pattern is selectively arranged directly on one of the cathode and anode, the individual insulating particles arranged such that the cathode and the anode do not contact each other.

3. The battery according to claim 1, wherein a void ratio of the interstitial spaces to the individual insulating particles in the electrolyte layer is 50-90%.

4. The battery according to claim 1, wherein a mean radius of the individual insulating particles is 0.05-10 μm.

5. The battery according to claim 1, wherein a thickness of the electrolyte layer is 10 μm or less.

6. The battery according to claim 1, wherein the electrolyte is a solid electrolyte.

7. The battery according to claim 1, wherein the individual insulating particles comprise olefin resins.

8. The battery according to claim 1, wherein the individual insulating particles are inorganic oxides.

9. The battery according to claim 1, wherein the cathode comprises a cathode active material that is formed using lithium-transition metal composite oxides, and wherein the anode comprises an anode active material that is formed using carbon- or lithium-transition metal composite oxides.

10. A method for manufacturing a battery comprising:

applying individual insulating particles directly to at least one of a cathode and an anode;

applying an electrolytic polymer to at least some of a plurality of interstitial spaces between the individually applied insulating particles to form an electrolyte layer; and

layering the cathode and the anode such that the electrolyte layer is formed in between.

11. The method according to claim 10, wherein the electrolyte layer is formed by applying the individual insulating particles and the electrolytic polymer directly to at least one of the anode and the cathode through a nozzle of an ink-jet printer.

12. The method according to claim 10, wherein the electrolytic polymer is applied simultaneously with the individual insulating particles to form a solid electrolyte battery.

13. The method according to claim 10, wherein the individual insulating particles and electrolytic polymer are applied separately to form a solid electrolyte battery.

14. The method according to claim 10, wherein the thickness of the electrolyte layer is 10 μm or less.

15. A battery assembly comprising multiple connected batteries, wherein each of the connected batteries comprises:

layered cell elements including a cathode and an anode that are facing each other; and

an electrolyte layer between the cathode and the anode,

wherein lithium ions can be inserted into and removed from the cathode and the anode through the electrolyte layer,

wherein the electrolyte layer consists essentially of individual insulating particles individually applied directly to at least one of the cathode and the anode and affixed thereto, and electrolytes occupying at least some of a plurality of interstitial spaces between the individual insulating particles.

16. A vehicle having a battery assembly comprising multiple connected batteries mounted as a power supply for a drive train of the vehicle, wherein each of the connected batteries comprises:

layered cell elements including a cathode and an anode that are facing each other; and an electrolyte layer between the cathode and the anode,

wherein lithium ions can be inserted into and removed from the cathode and the anode through the electrolyte layer, and

wherein the electrolyte layer consists essentially of individual insulating particles individually affixed directly to at least one of the cathode and the anode and electrolytes positioned such that the electrolytes occupy at least some of a plurality of interstitial spaces between the affixed individual insulating particles.

20. The battery according to claim 1, wherein the arrangement of individual insulating particles is a patterned arrangement.

21. The battery according to claim 20, wherein the patterned arrangement is at least one of alternating rows of the individual insulating particles and the electrolyte, circles of the individual insulating particles and the electrolyte, columns formed by the adjacent individual insulating particles linearly connected with each other, a lattice-like arrangement, and columns formed by the adjacent insulating particles connected with each other in a zigzag.

22. The method according to claim 10, wherein the individual insulating particles and an electrolytic polymer are applied in a pattern.

23. The method according to claim 22, wherein the pattern is at least one of alternating rows of the individual insulating particles and the electrolyte, circles of the individual insulating particles and the electrolyte, columns formed by the adjacent individual insulating particles linearly connected with each other, a lattice-like arrangement, and columns formed by the adjacent insulating particles connected with each other in a zigzag.

24. The battery assembly according to claim 15, wherein the electrolyte layer comprises individual insulating particles and electrolytes arranged in a pattern.

25. The battery assembly according to claim 24, wherein the pattern is at least one of alternating rows of the individual insulating particles and the electrolyte, circles of the individual insulating particles and the electrolyte, columns formed by the adjacent individual insulating particles linearly connected with each other, a lattice-like arrangement, and columns formed by the adjacent insulating particles connected with each other in a zigzag.

26. The vehicle according to claim 16, wherein the electrolyte layer comprises individual insulating particles and electrolytes arranged in a pattern.

27. The vehicle according to claim 26, wherein the pattern is at least one of alternating rows of the individual insulating particles and the electrolyte, circles of the individual insulating particles and the electrolyte, columns formed by the adjacent individual insulating particles linearly connected with each other, a lattice-like arrangement, and columns formed by the adjacent insulating particles connected with each other in a zigzag.

APPENDIX B: Evidence

NONE

APPENDIX C: RELATED PROCEEDINGS APPENDIX

NONE